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ABSTRACT

Previous research using various measures of teacher quality has largely failed to investigate the relationships among such assessment measures using multivariate procedures. Multivariate investigations are essential in studies of teacher competence because these methods view various competency variables in the larger contexts to which researchers generalize their results One approach to conducting such an investigation is demonstrated through canonical correlation analysis of data from 496 student teachers enrolled at a comprehensive university in Mississippi. Measures of teacher knowledge, subtests of the National Teacher Examinations (NTE), and overall college grade point average (GPA) served as predictor variables. Measures of teaching performance, scores across several ratings on the Mississippi Teacher Assessment Instruments, and final student teaching grade served as criterion variables. The analysis yielded one statistically significant canonical root. Results suggest that the NTE subtest scores are not very good predictors of teaching performance, but that students' GPAs are relatively good predictors. (Author/SLD)

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PREDICTING TEACHING PERFORMANCE: A MULTIVARIATE INVESTIGATION

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ABSTRACT

Previous research using various measures of teacher quality has largely failed to investigate the relationships among such assessment measures using multivariate procedures. Multivariate investigations are essential in studies of teacher competence since these methods view various competency variables in the larger contexts to which researchers design their results to generalize. The author demonstrates one approach to conducting such an investigation with data from 496 student teachers using canonical correlation analysis. Measures of teacher knowledge (subtests of the NTE and overall college GPA) served as predictor variables and measures of teaching performance (scores across several ratings on the Mississippi Teacher Assessment Instruments and final student teaching grade) served as criterion variables. The analysis yielded one statistically significant canonical root. Results suggest that the NTE subtest scores are not very good predictors of teaching performance, but that students' GPAs are relatively good predictors.

PREDICTING TEACHING PERFORMANCE: A MULTIVARIATE INVESTIGATION

In recent years, institutions of higher learning and state teacher credentialing agencies have increasingly mandated several types of quantitative measures for prospective teachers in attempts to ensure the quality of teaching candidates. Pratt, Delucia, and Williams (1987) note that these measures have been particularly widely adopted among states in the southern United States. General tests of scholastic ability (e.g., the American College Test, the Scholastic Aptitude Test) have been used for initial screening of candidates prior to their entrance into college and early college success (usually measured by an overall college GPA) is often used to monitor entrance into a teacher education program. Tests to assess the knowledge base more specifically related to teaching have also been used, with the various component tests of the National Teacher Examinations (NTE) emerging as the most popularly used tests of this nature (Lines, 1985). In addition, measures of teaching performance have been utilized to quantitatively assess actually demonstrated teaching behaviors.

With teachers receiving an increasingly large amount of public scrutiny, many feel that use of such measures to document the performance of teacher candidates is justifiable. For example, as Egan and Ferre (1989, p. 227) have noted, "faculty members in teacher education programs need reliable information that can provide an accurate assessment of a student's potential for success, that is the ability [of the student] to complete educational requirements of a teacher education program and pass a competency examination." Similarly, Leiser (1981, p. 48) asserted, "a teacher [should] be able to demonstrate his or her competence in subject matter, in the English language, and in those other areas which every teacher ought to know before being

admitted to a classroom with a group of expectant children." Moreover, various state-by-state content validity studies (e.g., Hankins & Hancock, 1984) indicate that tests such as the NTE are generally felt to be appropriate indicators of a common knowledge base for teachers (Rosner & Howey, 1982). However, Book and Freeman (1986) found that prospective teachers place a higher value on content-specific courses and on-the-job experience than on pedagogy-related courses as a crucial source of professional knowledge.

Others doubt the usefulness of teacher testing, or at least recognize that testing is not a panacea for assuring teacher quality. For instance, Lines (1985, p. 618) argued that tests of the teacher's knowledge base

> . . . may measure the wrong things, introduce their own biases, or be otherwise poorly designed. They are also one-dimensional--measuring only knowledge and not other characteristics that make for an effective teacher, such as compassion, love of children, energy, wisdom, dedication, and similar qualities.

Similarly, Daniel, Siders, and Slick (1991) offer evidence to suggest that typically used measures of teacher performance in the classroom are subject to rater bias.

Overview of Previous Research on Teacher Competence Measures

Previous researchers have focused on the relationships among the three previously-mentioned types of measures (i.e., measures of general academic competence, measures of a specific knowledge base for teachers, measures of teaching performance) as well as other indicators of competence of teacher candidates. Not surprisingly, the

results of these studies have prompted researchers (e.g., White & Tierney, 1989) to recommend a focus on multiple measures of competence in making teacher licensure decisions.

Most previous studies have employed use of Pearson product-moment correlation coefficients or multiple regression procedures to determine the degree to which scores on one or more of the NTE subtests are related to various other measures of competence, with the NTE subtests often serving as dependent variables. For instance, Hall (1964) found "reasonably high" correlations between the original NTE's Weighted Common Exam scores and students' GPAs. Egan and Ferre (1989) found moderate to high correlations between students' GPAs and their scores on the professional knowledge, communication skills, and general knowledge NTE tests. White and Tierney (1989) found moderate relationships between English students' subject area GPAs and their scores on the English NTE specialty test. Erickson (1971) found a moderate negative correlation to exist between prospective English teachers' specialty area NTE and high school students' ratings of their student teaching performance on the Illinois Teacher Evaluation Questionnaire, suggesting that those with a more substantial knowledge based were perceived by students to be less effective. Using multiple regression procedures, Olstad, Beal, and Marrett (1985), found that college GPA and a general test of achievement were rather weak predictors of students' scores on the NTE science specialty tests. Elmore and Ellett (1978) found negative correlations among NTE scores and various measure of affective behavior.

Tests of general scholastic ability and tests of the teacher's knowledge base have

often been found to be highly correlated. (See, for example, studies by Egan & Ferre, 1989; Lovelace & Martin, 1984; Tarver & Carr, 1983). In fact, these relationships are so notable that Lovelace and Martin (1984, p. ii) have suggested that "perhaps students who score high on specific ACT subtests might be exempt from similar subtests on the revised NTE, thus saving students needless expense."

What has not sufficiently emerged from these studies is consistency in research design. For example, NTE specialty area tests have alternately served as both independent (Erickson, 1971) and dependent (White & Tierney, 1989) variables. Research design has also often failed to address the issues of most practical significance (Leiser, 1981). As Moore, Schurr, and Henriksen (1991, p. 1024) noted, "relatively few studies have evaluated correlations of the subtests with measures of teacher effectiveness." Interestingly, when such studies have been conducted, scores on NTE subtests have served as rather weak predictors of scores on measures of teaching performance (e.g., Brown & Wells, 1988; Lovelace & Martin, 1984; Moore, Schurr, & Henriksen, 1991; Salzman, 1989), suggesting that measures of the potential teacher's knowledge base as measured by the NTE do not indicate who the more successful teachers will be.

Purpose of the Present Study

To date, relatively few studies have employed effective means for determining the individual contributions of various variables to the prediction of teacher competence, and virtually none of the studies have used multivariate methods to assess the performance of the various measures of interest in light of their multivariate reality.

Consequently, the purpose of the present study was to investigate the relationships among a host of variables used to measure teacher competence collected on a sample of student teachers at a given university using appropriate multivariate methods.

Sample

The sample utilized for the present study consisted of teacher education students (n = 496) enrolled at a comprehensive university in Mississippi. All 496 students had completed their academic program, including student teaching. Data utilized for the study were gathered from archival records housed in the university's records office and office of educational field experiences. Both computerized and paper records were utilized. Variables of interest included the following:

(a) ACT scores--composite score as well as scores on the English, math, social studies, and science subtests;

(b) NTE scores--scores on each of the four components of the NTE (general knowledge test, communication skills test, professional knowledge test, and specialty area test).

(c) teaching performance scores--total scores on the Mississippi Teacher Assessment Instruments (MTAI) across two teaching situations and two raters (four evaluations per student) during the student teaching experience. The MTAI (Bureau of School Improvement, 1987) is purported to measure 14 teaching competencies across its 42 continuous items, resulting in three subscale scores, namely teaching plans and materials, position skills, and interpersonal skills. For purposes of the present study, the MTAI total scale scores were utilized since four different evaluations of the student were

utilized. Breaking down the total scale scores into the three subscales for each administration of the MTAI would have resulted in a very large and hard to manage set of variables.

The typical person in the sample was 29 years old (mean age of 29; SD = 7.25), female (89.2%), Caucasian (96.5%), and relatively a "good" student (mean GPA of 3.4; SD = .42). A wide variety of academic majors were represented, with elementary education majors (n = 284) being the largest subgroup (57.3%) of the sample. Of the 431 students for whom student teaching grades were available, 386 (89.6%) received As, 39 (9.0%) received Bs, and 6 (1.4%) received Cs.

Method

Once data were collected and coded, a canonical correlation analysis was performed using the SPSSx MANOVA procedure. By default, the MANOVA procedure conducts a canonical correlation analysis if no categorical independent variables are specified and if predictor variables for use in the canonical analysis are specified as covariates. Five variables were included in the teaching performance criterion variable set--total scores from the two MTAI evaluations by the university coordinator (MTAIUNI1 and MTAIUNI2), total scores from the two MTAI evaluations by the cooperating teacher in the school(s) in which the subject did student teaching (MTAISCH1 and MTAISCH2), and the student teaching final course grade (STGRA) received by the student. For STGRA, an A was assigned a value of 4, a B was assigned a value of 3, and a C was assigned a value of 2. The knowledge-base predictor variable set included four variables--the student's scores on the general knowledge (GKNTE),

communication skills (COMNTE), and professional knowledge (PKNTE) portions of the NTE and the student's overall university grade point average (GPA) based on a four point scale. The NTE specialty area test scores were not included in the analysis since students across different teaching majors took different area tests.

A single null hypothesis was proposed for investigation and subjected to empirical testing via the canonical correlation analysis:

> Teaching performance, as measured by four MTAI evaluations and student teaching outcome grade, will not be correlated at a statistically significant ($p = .05$) level with teachers' knowledge base, as measured by the student's overall university GPA and the general knowledge, communication skills, and professional knowledge subtests of the NTE.

Results

Intercorrelations among the four predictor and five criterion variables included in the canonical correlation analysis are presented in Table 1. Canonical correlation analysis creates weighted composites of the variables in each of the two variable sets and then computes a bivariate correlation between these two weighted composite variables. In essence, each variable is multiplied by a derived weight and then the weighted variables in each set are summed to produced a single "synthetic" variable. The bivariate correlation between these two variable composites is the canonical correlation (R_c).

INSERT TABLE 1 ABOUT HERE

For a given canonical correlation analysis, the number of canonical roots, or functions, yielded by the analysis is equal to the number of variables in the smaller variable set. In the present analysis, the predictor set included four variables and the criterion set included five variables; hence, the canonical analysis yielded four roots.

The four canonical functions derived from the analysis are presented in Table 2. Based on the magnitude of the effect (R_c^2) of the functions and considering their levels of statistical significance, only the first function was interpreted. This first function yielded a canonical correlation (R_c) of .490 (R_c^2= .240; $p < .001$), indicating that the academic performance predictor variables collectively accounted for approximately 24% of the variance in the scores on the five teaching performance variables. Consequently, the foregoing null hypothesis which stated that there would be no statistically significant relationship between the two variable sets was rejected.

INSERT TABLE 2 ABOUT HERE

When a noteworthy canonical function is interpreted, it is generally appropriate to determine the degree to which various variables included in the analysis have contributed to the canonical function. Canonical correlation analyses yields two sets of weights that have been proposed for use for this purpose, i.e., canonical function coefficients and canonical structure coefficients. Function coefficients are the derived weights applied to each of the variables in a given set in order to obtain the composite variate used in the canonical correlation analysis. Even though the absolute magnitude of the function coefficients may be somewhat reliable in determining the contribution of

a variable to the composite, it has been shown (e.g., Daniel, 1990; Thompson & Borrello, 1985) that the numerical values of these coefficients are highly affected by collinearity of variables in a given set as is often the case when employing canonical correlation. As shown in Table 1, variables included in the present analysis within the given sets have a relatively high degree of collinearity, suggesting that the function weights may not be reliable in indicating variable contributions.

Canonical structure coefficients may also be used to suggest the amount of variable contribution to a canonical function. Structure coefficients indicate the degree of correlation of a given variable in the set with the canonical composite for the variable set. Structure coefficients tend to be much less susceptible to instability due to multicollinearity of the variables in a given set. Hence, structure coefficients are generally considered as more reliable indicators of variable contribution.

The canonical function and structure coefficients for the variables in the predictor and criterion sets are presented in Table 3. Since only the first function was worthy of interpretation, the structure coefficients for this root only were interpreted. These coefficients indicate that all of the variables in the criterion set made noteworthy contributions (all structure coefficients exceed |.70|) to the composite, suggesting the importance of further study of these variables. These rather large structure coefficients also serve as an indication of the high degree of collinearity among the variables in this set.

INSERT TABLE 3 ABOUT HERE

Interestingly, only two of the predictor variables contributed to a substantial degree to the predictor variable composite, i.e., GPA (structure coefficient = -.937) and PKNTE (structure coefficient = -.359), with GPA making the most noteworthy contribution. Hence, it would appear that the general knowledge and communication portions of the NTE lack the ability to predict teaching performance of student teachers using total scores on the MTAI and student teaching grades as outcome variables.

Discussion

Few would debate the necessity of having quality teachers to staff America's schools; however, determining the most appropriate way to assure teacher quality is the source of much debate. In the present study two general sets of teacher competency measures were investigated, i.e., measures of the teacher's knowledge base and measures of the teacher's performance in the classroom. The foregoing results suggest that the two sets of competencies are indeed related to a moderate degree. What is most disillusioning, however, is the fact that the subtests of the NTE are for the most part poor predictors of teaching behavior. These findings are consistent with those of previous research studies which suggest that the teacher's knowledge base, especially as measured by tests such as the NTE, is not very highly related to actual teacher performance. By contrast, it would appear that GPA is a relatively good predictor of teaching performance.

One possible explanation for these findings would be that good scores on the NTE are a necessary but not a sufficient requirement for good teaching ability. In other words, a person who could not obtain a minimal "cut" score on the NTE subtests would

find it hard to be successful as a teacher, but not everyone who obtains above the cut score level will necessarily be a good teacher. One might further argue that by allowing only those students who have been successful at meeting a minimal performance level on one or more parts of the NTE to be allowed to continue in a teacher education program, a portion of the variance in the NTE scores has already been eliminated; hence, the correlations among NTE scores and other variables of interest will be somewhat diminished. This is not likely, however. GPA is often used as a screening device, and it appears to maintain its power as a predictor of teaching performance despite the fact that persons with lower GPAs are, in effect, removed from the sample early in the teacher screening process.

Of the three NTE subtests included in the present study, it is interesting that the professional knowledge subtest made the greatest contribution to the canonical analysis. This result may indicate that more generalized academic functioning as measured by the general knowledge and communication skills subtests does not necessarily contribute to one's teaching ability, but that there is value in the professional "know-how" that teachers gain as part of participating in a teacher education program. This finding may offer evidence that teaching has begun to develop a focused knowledge base on which effective teaching practices are developed. The absence of such a knowledge base has often been cited as a reason for the lack of professional status of teaching. By contrast, the recognition of a commonly recognized body of professional knowledge which can be shown to be related to appropriate teaching performance may do much to raise the occupational status of teaching.

Effective teaching requires many basic teacher competencies. None of these competencies exists in a vacuum; in fact, the teacher candidate is developing a host of these skills simultaneously. Moreover, there exists a complicated web of relationships among all of these skills as well as other facets of the prospective teacher's life experiences. The present study has demonstrated via multivariate methods a research design that is sensitive to these realities. Additional studies of this nature are needed to further investigate these complicated relationships. For example, one desirable strategy would be to break down effective teaching into a number of behaviors rather than using a global teaching performance score (e.g., the MTAI total score) as used in the present study. As noted previously, the MTAI total score can be further divided into three subscales measuring competencies related to (a) teaching plans and materials, (b) interpersonal skills, and (c) position skills, each of which could serve as a separate dependent variable in a multivariate analysis. Conducting further studies of this type would provide evidence regarding those variables which best correlate with teaching behaviors when considered in the light of other significant variables.

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Table 1
Intercorrelations Among Variables

	MTAISCH1	MTAISCH2	MTAIUNI1	MTAIUNI2	STGRA	COMNTE	PKNTE	GKNTE	GPA
MTAISCH1	1.0000	.4315	.7843	.4196	.5949	.0832	.1763	.0252	.3404
	(0)	(421)	(439)	(421)	(427)	(437)	(429)	(438)	(408)
	P= .	P= .000	P= .000	P= .000	P= .000	P= .041	P= .000	P= .300	P= .000
MTAISCH2	.4315	1.0000	.4800	.6879	.6533	.0448	.1468	-.0259	.3571
	(421)	(0)	(421)	(425)	(424)	(424)	(415)	(425)	(396)
	P= .000	P= .	P= .000	P= .000	P= .000	P= .179	P= .001	P= .298	P= .000
MTAIUNI1	.7843	.4800	1.0000	.6327	.6866	.0521	.1412	-.0054	.4011
	(439)	(421)	(0)	(421)	(427)	(437)	(429)	(438)	(408)
	P= .000	P= .000	P= .	P= .000	P= .000	P= .139	P= .002	P= .455	P= .000
MTAIUNI2	.4196	.6879	.6327	1.0000	.6417	.0273	.1219	-.0611	.4218
	(421)	(425)	(421)	(0)	(424)	(424)	(415)	(425)	(396)
	P= .000	P= .000	P= .000	P= .	P= .000	P= .288	P= .006	P= .104	P= .000
STGRA	.5949	.6533	.6866	.6417	1.0000	.0703	.1258	.0103	.4038
	(427)	(424)	(427)	(424)	(0)	(430)	(422)	(431)	(401)
	P= .000	P= .000	P= .000	P= .000	P= .	P= .073	P= .005	P= .416	P= .000
COMNTE	.0832	.0448	.0521	.0273	.0703	1.0000	.6441	.7240	.2647
	(437)	(424)	(437)	(424)	(430)	(0)	(473)	(494)	(461)
	P= .041	P= .179	P= .139	P= .288	P= .073	P= .	P= .000	P= .000	P= .000
PKNTE	.1763	.1468	.1412	.1219	.1258	.6441	1.0000	.5897	.4284
	(429)	(415)	(429)	(415)	(422)	(473)	(0)	(474)	(442)
	P= .000	P= .001	P= .002	P= .006	P= .005	P= .000	P= .	P= .000	P= .000
GKNTE	.0252	-.0259	-.0054	-.0611	.0103	.7240	.5897	1.0000	.2525
	(438)	(425)	(438)	(425)	(431)	(494)	(474)	(0)	(462)
	P= .300	P= .298	P= .455	P= .104	P= .416	P= .000	P= .000	P= .	P= .000
GPA	.3404	.3571	.4011	.4218	.4038	.2647	.4284	.2525	1.0000
	(408)	(396)	(408)	(396)	(401)	(461)	(442)	(462)	(0)
	P= .000	P= .000	P= .000	P= .000	P= .000	P= .000	P= .000	P= .000	P= .

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Table 2
Eigenvalues and Canonical Correlations

Root No.	Eigenvalue	Pct.	Cum. Pct.	Canon. Cor.	Squared Cor.
1	.315	90.473	90.473	.490	.240
2	.026	7.482	97.955	.159	.025
3	.007	1.910	99.866	.081	.007
4	.000	.134	100.000	.022	.000

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Table 3
Canonical Function and Structure Coefficients

Standardized canonical function coefficients for DEPENDENT variables

	Function No.			
Variable	1	2	3	4
MTAISCH1	-.240	.788	1.004	-1.127
MTAISCH2	-.175	.799	.141	1.266
MTAIUNI1	-.132	-.484	-.163	1.313
MTAIUNI2	-.515	.331	-.919	-1.195
STGRA	-.140	-1.367	.154	-.215

Structure coefficients for DEPENDENT variables

	Function No.			
Variable	1	2	3	4
MTAISCH1	-.721	.065	.650	-.149
MTAISCH2	-.800	.242	-.036	.394
MTAIUNI1	-.806	-.196	.254	.154
MTAIUNI2	-.906	.065	-.401	-.120
STGRA	-.817	-.467	.166	.061

Standardized canonical function coefficients for PREDICTOR variables

	Can. Var.			
Predictor	1	2	3	4
COMNTE	-.020	-.383	.416	-1.498
PKNTE	-.227	1.182	.629	.417
GKNTE	.450	-.855	.171	1.161
GPA	-.967	-.407	-.307	.113

Structure coefficents for PREDICTOR variables

	Can. Var.			
Predictor	1	2	3	4
COMNTE	-.156	-.366	.854	-.335
PKNTE	-.359	.242	.882	.188
GKNTE	.019	-.531	.772	.349
GPA	-.937	-.296	.135	.125